CERTIFICATE OF TRANSLATION

As a below named translator, I hereby declare that my residence and citizenship are as stated below next to my name and I hereby certify that I am conversant with both the English and Korean languages and the document enclosed herewith is a true English translation of the Priority Document with respect to the Korean patent application No. **2000-61835** filed on **October 20, 2005.**

NAME OF THE TRANSLATOR : Hyang-Suk KO

SIGNATURE : Hyang-Suk Ko **Date** : August 24, 2005

RESIDENCE : MIHWA BLDG., 110-2, MYONGRYUN-DONG 4-GA, CHONGRO-GU, SEOUL 110-524, KOREA

CITIZENSHIP : REPUBLIC OF KOREA

Translation of Priority Document

THE KOREAN INTELLECTUAL PROPERTY OFFICE

This is to certify that annexed hereto is a true copy from the records of the Korean Intellectual property Office of the following application as filed

Application Number	:	Patent Application No. 2000-61835
Date of Application	:	October 20, 2000
Applicant(s)	:	Samsung Electronics Co., Ltd.

COMMISSIONER

[ABSTRACT OF THE DISCLOSURE]

[ABSTRACT]

Disclosed are a method and an apparatus for transmitting a burst pilot signal used as an amplitude reference signal by loading information bits to the burst pilot signal using a QAM scheme when transmitting data. The information bits are loaded to components of the burst pilot signal, except for an amplitude component, based on an output position and an output sign of a burst pilot symbol and a Walsh code used for Walsh covers.

[REPRESENTATIVE FIGURE]

FIGURE 1

[INDEX]

16-QAM, burst pilot, burst pilot data modulation, Walsh cover

[SPECIFICATION]

[TITLE OF THE INVENTION]

APPARATUS AND METHOD FOR TRANSMITTING BURST PILOT IN MOBILE COMMUNICATION SYSTEM

[BRIEF DESCRIPTION OF THE DRAWINGS]

FIG. 1 is a view illustrating a structure of an apparatus for transmitting a burst pilot providing an amplitude reference of a modulated symbol, which is required for demodulating data at a receiver when data are transmitted through a 16-QAM scheme;

FIG. 2 is a view illustrating a structure of a 1.25msec slot consisting of packet data and burst pilot symbols;

FIGS. 3a to 3c are views illustrating various schemes for loading information to a burst pilot symbol according to an embodiment of the present invention;

FIG. 4 is a view illustrating another structure of a 1.25msec slot consisting of packet data and burst pilot symbols;

FIGS. 5a to 5c are views illustrating various schemes for loading information to two consecutive burst pilot symbols according to another embodiment of the present invention; and

FIGS. 6a and 6b are views illustrating schemes for loading information to a burst pilot symbol according to still another embodiment of the present invention.

[DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT]

[OBJECT OF THE INVENTION]

[RELATED FIELD AND PRIOR ART OF THE INVENTION]

The present invention relates to a mobile communication system. More particularly, the present invention relates to an apparatus and a method for transmitting information through a pilot channel.

Recently, a mobile communication system supporting a high-speed packet data service in addition to a voice service has been proposed to meet the requirement for high-speed data transmission. In the mobile communication system supporting the high-speed packet data transmission, a transmitter transmits data by performing QAM (Quadrature Amplitude Modulation) to the data. Further, the transmitter transmits a time-continuous common pilot channel and a time-discontinuous burst pilot channel.

Generally, a phase modulation scheme such as QPSK (Quadrature Phase Shift Keying) includes information in a phase component of a modulated symbol. Therefore, a receiver demodulates the modulated symbol by utilizing the common pilot channel as a phase reference signal. However, a QAM scheme includes information in amplitude and phase components of the modulated symbol. For example, when the system supporting the high-speed data transmission employs 16-QAM or 64-QAM for packet data transmission, the receiver requires an amplitude reference of a demodulated symbol in order to correctly demodulate the information included in the modulated symbol. Therefore, the transmitter must transmit both a phase reference signal and an amplitude reference signal of the modulated symbol. That is, when the

transmitter employing the QAM scheme transmits data at constant transmission power, the common pilot channel can be used as both the phase reference and the amplitude reference. However, when the transmission power varies at every predetermined interval, a reference signal providing an amplitude reference of the QAM-modulated symbol is required. To provide the amplitude reference of the QAM-modulated symbol, the burst pilot channel is typically used. Since the burst pilot is used to provide only the amplitude reference of the modulated symbol, it is possible to transmit additional information by using other components of the QAM-modulated symbol, except for the amplitude component.

[SUBSTANTIAL MATTER OF THE INVENTION]

Therefore, it is an object of the present invention to provide an apparatus and a method for transmitting side information using components of a burst pilot signal, except for an amplitude component of the burst pilot signal, when a common pilot signal is used as a phase reference and the burst pilot signal is used as the amplitude reference signal in a QAM scheme for transmitting both a phase reference signal and the amplitude reference signal.

To achieve the above object, there is provided an .

[CONSTRUCTION AND OPERATION OF THE INVENTION]

Hereinafter, preferred embodiments of the present invention will be described with reference to the accompanying drawings.

In the following description, the same reference numerals will be used for the same elements even if they are shown in different drawings. In addition, well-

The present invention provides an apparatus and a method for transmitting side information by loading the side information to a burst pilot providing an amplitude reference of a modulated symbol, which is required for QAM-demodulating the modulated symbol at a receiver when data are transmitted through a QAM scheme.

FIG. 1 illustrates a structure of a transmitter for transmitting information by loading the information to a burst pilot according to an embodiment of the present invention. Particularly, the transmitter shown in FIG. 1 includes a burst pilot data modulator 10 and an orthogonal spreader (Walsh cover) 20. Upon receiving a symbol of '0', the burst pilot data modulator 10 positions the received symbol in an I channel or a Q channel according to an information bit to be transmitted, or converts the received symbol to a symbol of '0' or '1'. The converted symbol is spread with a predetermined Walsh code for the burst pilot by the Walsh cover 20, and then, output in a chip unit. When transmitting side information using the Walsh cover 20 rather than the burst pilot data modulator 10, the Walsh cover 20 multiplies the side information by a predetermined Walsh code according to the information bit to be transmitted.

Referring to FIG. 1, input preamble symbols having values of '0's are input into a signal point mapper 201 and mapped to '+1' by the signal point mapper 201. The output symbols of the signal point mapper 201 are input into a Walsh cover 202 and spread by the Walsh cover 202 with a specific 64-ary biorthogonal Walsh code (or sequence) associated with a user's unique MAC ID

The output sequences of the Walsh cover 202 are input into a sequence repeater 203 so that they are subject to sequence repetition according to a transmission rate. The output sequences of the Walsh cover 202 can be repeated by the sequence repeater 203 as many as a maximum of 16 times according to the transmission rates. Therefore, the PSCH included in one slot of the DTCH can continue for 64 chips to 1,024 chips as a maximum according to the transmission rates. The output sequences (I and Q-channel sequences) of the sequence repeater 203 are input into a time division multiplexer (TDM) 230 so that they are multiplexed with the PICH and DTSCH.

A channel-coded bit sequence is input into a scrambler 211 and scrambled by the scrambler 211. Then, the output sequence of the scrambler 211 is input into a channel interleaver 212 and interleaved by the channel interleaver 212. At this time, the size of the channel interleaver 212 depends on the size of a physical layer packet. The output sequence of the channel interleaver 212 is input into an M-ary symbol modulator 213 and mapped to M-ary symbols by the M-ary symbol modulator 213. The M-ary symbol modulator 213 serves as the QPSK (Quadrature Phase Shift Keying), 8-PSK (8-ary Phase Shift Keying) or 16-QAM (Quadrature Amplitude Modulation) modulator according to the transmission rates, and it is also possible to change the modulation mode in a unit of the physical layer packet having a variable transmission rate. The I and Q sequences of the M-ary symbols output from the M-ary symbol modulator 213 are input into a sequence repeater/symbol puncturer 214 so that they are subject

to sequence repetition/symbol puncturing according to the transmission rate in the sequence repeater/symbol puncturer 214. The I and Q sequences of the M-ary symbols output from the sequence repeater/symbol puncturer 214 are input into a symbol demultiplexer 215. The I and Q sequences of the M-ary symbols input into the symbol demultiplexer 215 are demultiplexed into N Walsh code channels available for the DTSCH. The number N of the Walsh codes used for the DTSCH is variable. Information related to the number N of the Walsh codes is broadcasted through a Walsh space indication sub-channel (WSISCH) and a mobile station determines a transmission rate of a base station by taking the information into consideration. After that, the mobile station requests the base station to send data according to the determined transmission rate. Therefore, the mobile station can recognize the allocation state of the Walsh codes used for the currently received DTSCH. The I and Q sequences, which are demultiplexed into the N Walsh code channels, output from the symbol demultiplexer 215 are input into Walsh covers 216 so that they are spread with a specific Walsh code, respectively. Then, the I and Q sequences output from the Walsh cover 216 are input into a Walsh channel gain controller 217 and gain-controlled by means of the Walsh channel gain controller 217. The N I and Q sequences output from the Walsh channel gain controller 217 are input into a Walsh chip level summer 218 and summed up in a chip unit by the Walsh chip level summer 218. The I and Q chip sequences output from the Walsh chip level summer 218 are input into the time division multiplexer 230 so that they are multiplexed with the PICH and PSCH.

The burst pilot data modulator 10 (hereinafter, simply referred to as

"modulator") basically performs signal mapping (0→+1, 1→-1) with respect to the input pilot channel data (all '0's) and outputs modulated pilot symbols. In this process, the modulator 10 determines and outputs a sign of the modulated pilot symbols according to the input information bit. For example, the modulator 10 outputs a modulated pilot symbol having a positive sign (+) if the input information bit is '0', and a modulated pilot symbol having a negative sign (-) if the input information bit is '1'.

As another example, the modulator 10 performs the signal mapping on the input pilot channel data, and outputs the mapped signal through a channel selected according to the input transmission information bit. For instance, the modulator 10 outputs the signal through the I channel if the input information bit is '0' and through the Q channel if the input information bit is '1'.

The Walsh cover 20 multiplies the signal output from the modulator 10 by the predetermined Walsh code, thereby outputting the orthogonal-spread signal.

As mentioned above, the side information can be loaded to the burst pilot by controlling the modulator 10. In addition, the side information can be loaded to the burst pilot by spreading the data using the Walsh cover 20 with predetermined Walsh codes selected from among a plurality of input information bits allocated for the burst pilot according to the input information bit.

A method for expressing the side information transmitted through the modulator 10 and the Walsh cover 20 must be previously agreed between the transmitter and the receiver. Table 1 shows an information bit allocation and a method for expressing symbols selected according to the transmission

information bit (0 or 1) in the modulator 10. In Table 1, 'X' indicates that the transmitter and the receiver are fixed according to the agreement between the transmitter and the receiver.

Table 1

Tx Info bit(s)	Method of Expressing Symbols and Assigning Info Bits Per Symbol by Burst Pilot Data Modulator			Related Drawing
	Symbol Num.	Symbol output Pos	Symbol output Sign	
1	1 symbol (128-chip length)	X (0 bit/symbol)	Positive/Negative (1 bit/symbol)	FIG. 3a
1	1 symbol (128-chip length)	I channel/Q channel (1 bit/symbol)	X (0 bit)	FIG. 3b
2	1 symbol (128-chip length)	I channel/Q channel (1 bit/symbol)	Positive/Negative (1 bit/symbol)	FIG. 3c
2	2 symbols (64-chip length)	X (0 bit/symbol)	Positive/Negative (1 bit/symbol)	FIG. 5a
2	2 symbols (64-chip length)	I channel/Q channel (1 bit/symbol)	X (0 bit)	FIG. 5b
4	2 symbols (64-chip length)	I channel/Q channel (1 bit/symbol)	Positive/Negative (1 bit/symbol)	FIG. 5c

FIG. 2 illustrates a structure of a 1.25msec slot consisting of packet data symbols and burst pilot symbols. As illustrated in FIG. 2, one slot consists of two half slots, and the burst pilot symbol is positioned in a first field of each half slot with 128-chip length. When one 128-chip burst pilot symbol is constructed as shown in FIG. 2, it is possible to transmit a maximum of 2 information bits according to a sign and a position of the output burst pilot symbol. If it is necessary to transmit information of one bit only, the information is loaded to the

... given on the assumption that the slot has the structure as shown in FIG. 2. FIGS. 3a to 3c illustrate various schemes for loading information to the burst pilot symbol according to an embodiment of the present invention.

FIG. 3a illustrates a scheme for loading information to a sign of a symbol transmitted through an I channel. For instance, the symbol is transmitted with a positive sign (or negative sign) if the information bit is '0' and the modulated symbol is transmitted with a negative sign (or positive sign) if the information bit is '1'. In this manner, the 1-bit information is transmitted. It is also possible to load the information to the sign of the symbol transmitted through the Q channel, instead of the symbol transmitted through the I channel.

FIG. 3b illustrates a scheme for loading information to the I or Q channel. An output sign of the symbol is preset to a positive (+) and the information is loaded on the I channel or Q channel. For example, the symbol is transmitted through the I channel (or Q channel) if the information bit is '0' and the symbol is transmitted through the Q channel (or I channel) if the information bit is '1'. In this manner, 1-bit information is transmitted. It is also possible to previously set the output sign of the symbol to a negative (-) instead of the positive (+).

FIG. 3c illustrates a scheme obtained by combining schemes shown in FIGS. 3a and 3b. According to the scheme shown in FIG. 3c, 2-bit information is transmitted using the output sign and output position of the symbol. For instance, if a first information bit is '0', the symbol is transmitted with a positive sign (or negative sign) and if the first information bit is '1', the symbol is transmitted

with a negative sign (or positive sign). In addition, if a second information bit is '0', the symbol is transmitted through the I channel (or Q channel). Otherwise, if the second information bit is '1', the symbol is transmitted through the Q channel (or I channel).

FIG. 4 illustrates another structure of a 1.25msec slot consisting of packet data symbols and burst pilot symbols. As illustrated in FIG. 4, one slot consists of two half slots and the burst pilot consists of two consecutive 64-chip symbols positioned in a first field of each half slot. When two 64-chip burst pilot symbols are constructed as shown in FIG. 4, it is possible to transmit a maximum of 4-bit information according to an output sign or an output position of the symbol. The following description of FIGS. 5a to 5c will be given on the assumption that the slot has the structure as illustrated in FIG. 4. FIGS. 5a to 5c are views illustrating various schemes for loading information to burst pilot symbols according to another embodiment of the present invention.

Referring to FIG. 5a, if the first field of the half slot includes two 64-chip burst pilot symbols, the information bits are transmitted by designating an output sign (+/-) of the symbol to the information bits, respectively. For instance, if the first information bit is '0', the first symbol signal is transmitted with a positive sign (or negative sign). If the first information bit is '1', the first symbol signal is transmitted with a negative sign (or positive sign). In addition, if the second information bit is '0', the second symbol signal is transmitted with a positive sign (or negative sign). If the second information bit is '1', the second symbol signal is transmitted with a negative sign (or positive sign). That is, since one information bit is transmitted per one symbol, it is possible to transmit two

information bits during the transmission of two symbol signals. The output sign of the symbol can be previously fixed to a positive (+) or a negative (-) according to the information to be transmitted.

Referring to FIG. 5b, two symbols are transmitted by loading the information bit to each symbol. For example, if the first information bit is '0', the first symbol is transmitted through the I channel (or Q channel). If the first information bit is '1', the first symbol is transmitted through the Q channel (or I channel). In addition, if the second information bit is '0', the second symbol is transmitted through the I channel (or Q channel). If the second information bit is '1', the second symbol is transmitted through the Q channel (or I channel). That is, since one information bit is transmitted per one symbol, it is possible to transmit 2-bit information during the transmission of the two symbols.

Referring to FIG. 5c, a maximum of four information bits can be transmitted by loading two information bits to each symbol according to the output sign and the output position of the symbol. The output sign and the output position of the symbol are previously determined according to the information bit to be transmitted. For instance, the first symbol is transmitted with a negative sign (-) or a positive sign (+) according to the first information bit, and the first symbol is transmitted through the I channel or the Q channel according to the second information bit. In addition, the second symbol is transmitted with a negative sign (-) or a positive sign (+) according to the third information bit, and the second symbol is transmitted through the I channel or the Q channel according to the fourth information bit.

In the meantime, it is also possible to transmit the side information using

the Walsh cover 20, rather than the modulator 10. In general, symbols output from the modulator 10 are input into the Walsh cover 20. The Walsh cover 20 spreads the symbols with a predetermined Walsh code in order to distinguish the burst pilot symbols from other code channels. If the number of the predetermined Walsh codes for the burst pilot channel is one, it is impossible to load the side information to the Walsh code to be spread. However, if two Walsh codes are used, it is possible to transmit one information bit. If the symbols output from the modulator 10 are spread with one Walsh code selected from 2N Walsh codes, it is possible to transmit N information bits. In this case, it should be previously agreed between the transmitter and the receiver such that the 2N Walsh codes can be used between the transmitter and the receiver.

FIGS. 6a and 6b are views illustrating various schemes for loading information to the burst pilot symbol according to still another embodiment of the present invention.

Referring to FIG. 6a, a modulated pilot symbol output from the modulator 10 is spread with one Walsh code selected from two Walsh codes according to the information bit to be transmitted. The Walsh codes can be selectively used according to the information bit to be transmitted. When the Walsh codes having i^{th} and j^{th} indexes for spreading a symbol having 128 chip length are defined as W(128, i) and W(128, j), respectively, the Walsh cover 20 spreads the symbol output from the modulator 10 with W(128, i) (or W(128, j)) if the information bit to be transmitted is '0' and spreads the symbol with W(128, j) (or W(128, i)) if the information bit to be transmitted is '1', thereby transmitting 1-bit information. Herein, it is possible to transmit N-bit information by selecting

one of the 2N Walsh codes. When used together with the scheme shown in FIGS. 3a and 3b, this scheme can transmit (n+1)-bit information. Further, when used together with the scheme shown in FIG. 3c, this scheme can transmit (n+2)-bit information.

Referring to FIG. 6b, a modulated pilot symbol output from the modulator 10 is spread with one Walsh code selected from two Walsh codes according to the information bit to be transmitted. When the Walsh codes having i^{th} and j^{th} indexes are defined as W(64, i) and W(64, j), respectively, the Walsh cover 20 spreads the symbol output from the modulator 10 with W(64, i) (or W(64, j)) if the first information bit to be transmitted is '0' and spreads the symbol with W(64, j) (or W(64, i)) if the first information bit to be transmitted is '1', thereby transmitting 1-bit information. In addition, the Walsh cover 20 spreads the symbol output from the modulator 10 with W(64, i) (or W(64, j)) if the second information bit to be transmitted is '0' and spreads the symbol with W(64, j) (or W(64, i)) if the second information bit to be transmitted is '1', thereby transmitting 1-bit information. In this way, it is possible to transmit 2N information bits by selecting one of the 2N Walsh codes for spreading. In this case, if the above scheme is used together with the scheme shown in FIGS. 5a and 5b, information of (2n+2) bits can be transmitted through the above scheme. Further, when used together with the scheme shown in FIG. 5c, the above scheme can transmit (2n+4)-bit information.

While the invention has been shown and described with reference to a certain preferred embodiment thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without

departing from the spirit and scope of the invention as defined by the appended claims.

[EFFECTS OF THE INVENTION]

As described above, the apparatus and the method according to the present invention can transmit side information bits through the burst pilot channel according to the number of modulated pilot symbols, the output position of the pilot symbol, the sign of the pilot symbol and the number of Walsh codes used for the burst pilot channel.

[CLAIMS]

1. An apparatus for transmitting a time-discontinuous burst pilot in a mobile communication system, the apparatus comprising:

a modulator for outputting a modulated pilot symbol by determining a sign of the modulated pilot symbol according to an information bit to be transmitted; and

a Walsh cover for spreading the modulated pilot symbol output from the modulator by multiplying the modulated pilot symbol by a predetermined Walsh code.

2. An apparatus for transmitting a time-discontinuous burst pilot in a mobile communication system, the apparatus comprising:

a modulator for outputting a modulated pilot symbol through one of I and Q channels according to an information bit to be transmitted; and

a Walsh cover for spreading the modulated pilot symbol output from the modulator through the selected channel by multiplying the modulated pilot symbol by a predetermined Walsh code.

3. An apparatus for transmitting a time-discontinuous burst pilot in a mobile communication system, the apparatus comprising:

a modulator for outputting a modulated pilot symbol by modulating pilot data; and

a Walsh cover for spreading the modulated pilot symbol output from the

modulator by multiplying the modulated pilot symbol by a predetermined Walsh code, which is preset for the burst pilot symbol and selected from a plurality of Walsh codes corresponding to an information bit to be transmitted.

4. A method for transmitting a time-discontinuous burst pilot in a mobile communication system, the method comprising the steps of:

determining a sign of a modulated pilot symbol according to an information bit to be transmitted; and

spreading the modulated pilot symbol by multiplying the modulated pilot symbol by a predetermined Walsh code.

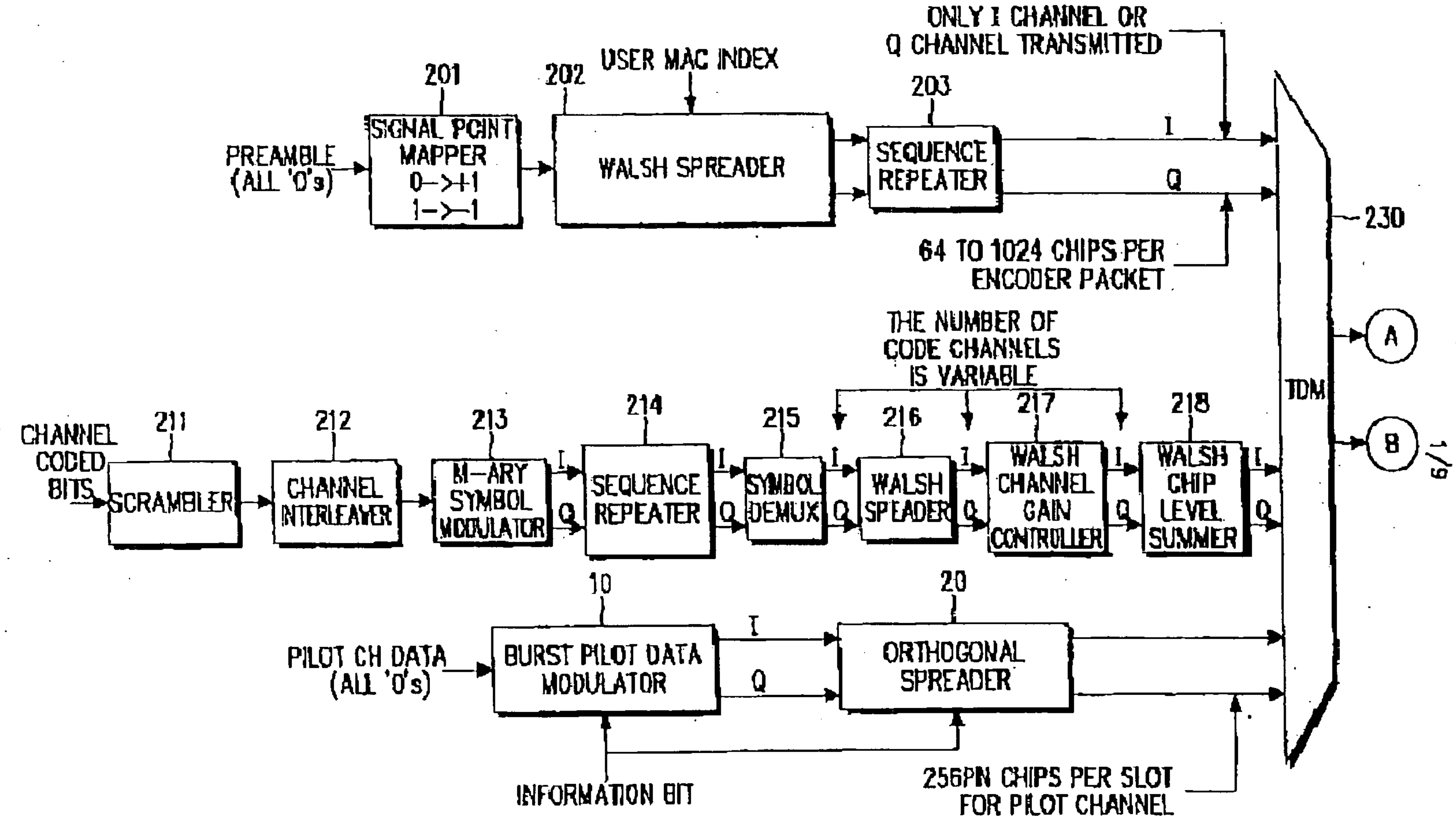
PREAMBLE (ALL '0's)
201
SIGNAL POINT MAPPER 0->+1 1->-1
202
USER MAC INDEX
WALSH SPREADER
203
SEQUENCE REPEATER
ONLY I CHANNEL OR Q CHANNEL TRANSMITTED
I
Q
64 TO 1024 CHIPS PER ENCODER PACKET
230
TDM
A
B
CHANNEL CODED BITS
211
SCRAMBLER
212
CHANNEL INTERLEAVER
213
M-ARY SYMBOL MODULATOR
214
SEQUENCE REPEATER
215
SYMBOL DEMUX
THE NUMBER OF CODE CHANNELS IS VARIABLE
216
WALSH SPEADER
217
WALSH CHANNEL GAIN CONTROLLER
218
WALSH CHIP LEVEL SUMMER
PILOT CH DATA (ALL '0's)
10
BURST PILOT DATA MODULATOR
20
ORTHOGONAL SPREADER
INFORMATION BIT
256PN CHIPS PER SLOT FOR PILOT CHANNEL

FIG. 1

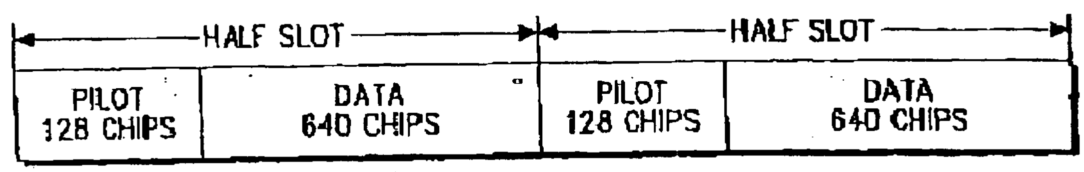
HALF SLOT
HALF SLOT
PILOT 128 CHIPS
DATA 640 CHIPS
PILOT 128 CHIPS
DATA 640 CHIPS

FIG. 2

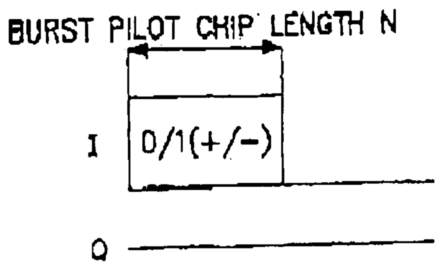
BURST PILOT CHIP LENGTH N
I
0/1(+/-)
Q

FIG. 3A

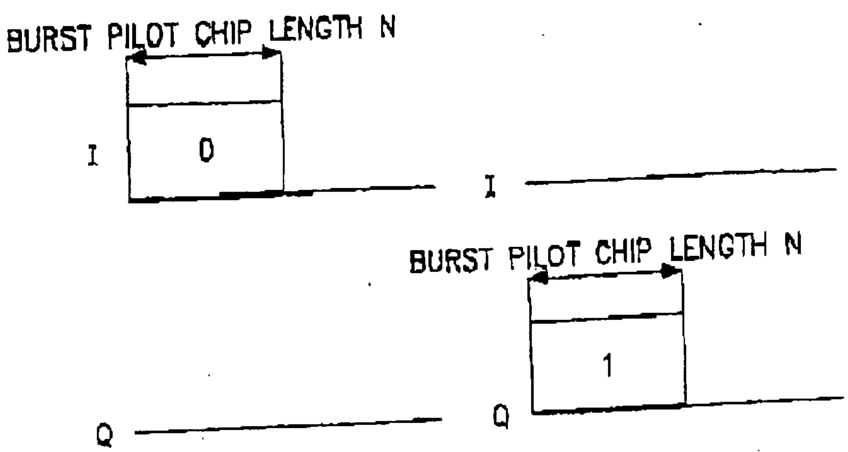
BURST PILOT CHIP LENGTH N
I
0
Q
I
BURST PILOT CHIP LENGTH N
1
Q

FIG. 3B

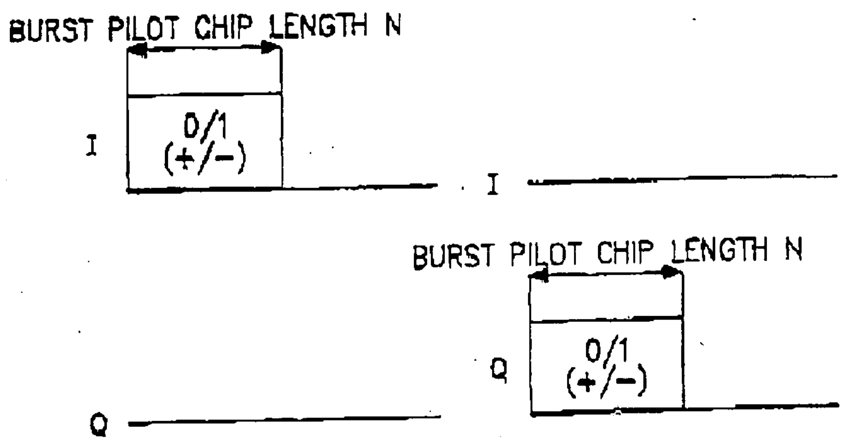
BURST PILOT CHIP LENGTH N
I
0/1
(+/-)
I
BURST PILOT CHIP LENGTH N
Q
0/1
(+/-)
Q

FIG. 3C

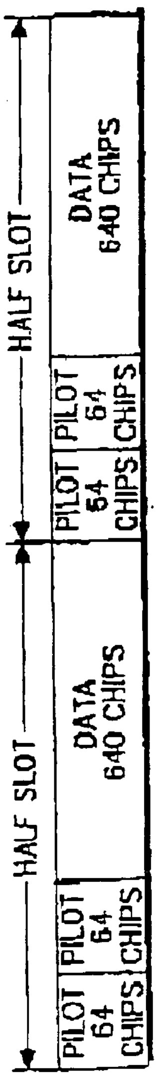
HALF SLOT
HALF SLOT
PILOT 64 CHIPS
PILOT 64 CHIPS
DATA 640 CHIPS
PILOT 64 CHIPS
PILOT 64 CHIPS
DATA 640 CHIPS

FIG. 4

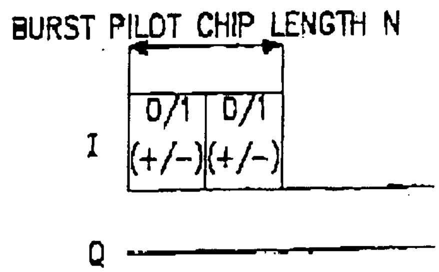
BURST PILOT CHIP LENGTH N
0/1
(+/-)
0/1
(+/-)
I
Q

FIG. 5A

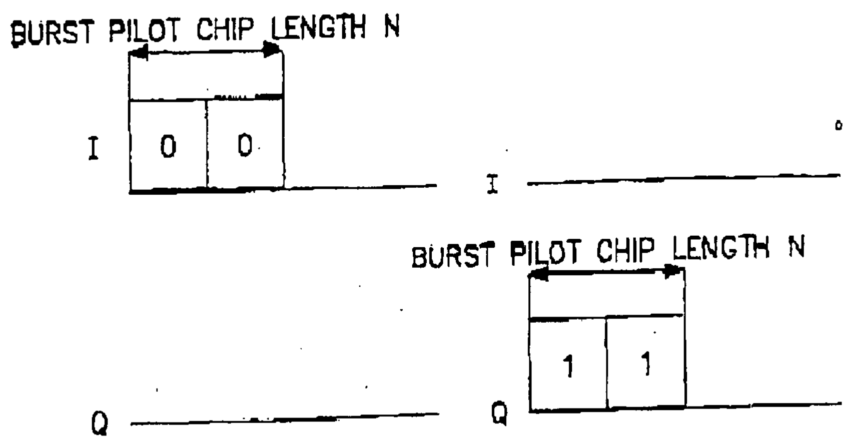
BURST PILOT CHIP LENGTH N
I
0
0
Q
I
BURST PILOT CHIP LENGTH N
1
1
Q

FIG. 5B

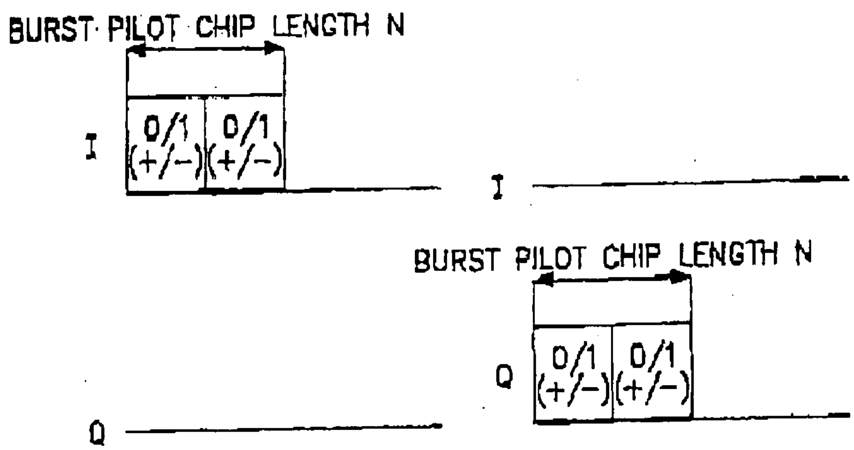
BURST PILOT CHIP LENGTH N
I
0/1
(+/-)
0/1
(+/-)
Q
I
BURST PILOT CHIP LENGTH N
Q
0/1
(+/-)
0/1
(+/-)

FIG. 5C

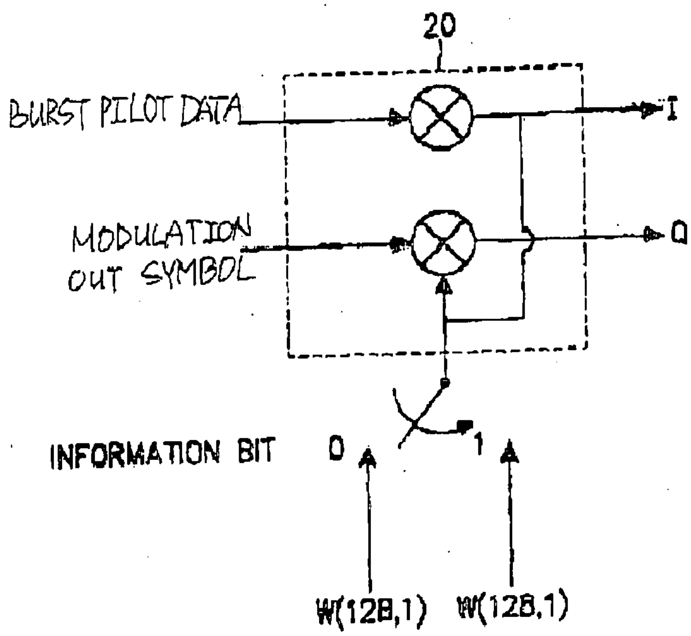
20
BURST PILOT DATA
I
MODULATION OUT SYMBOL
Q
INFORMATION BIT
0
1
W(128,1)
W(128,1)

FIG. 6A

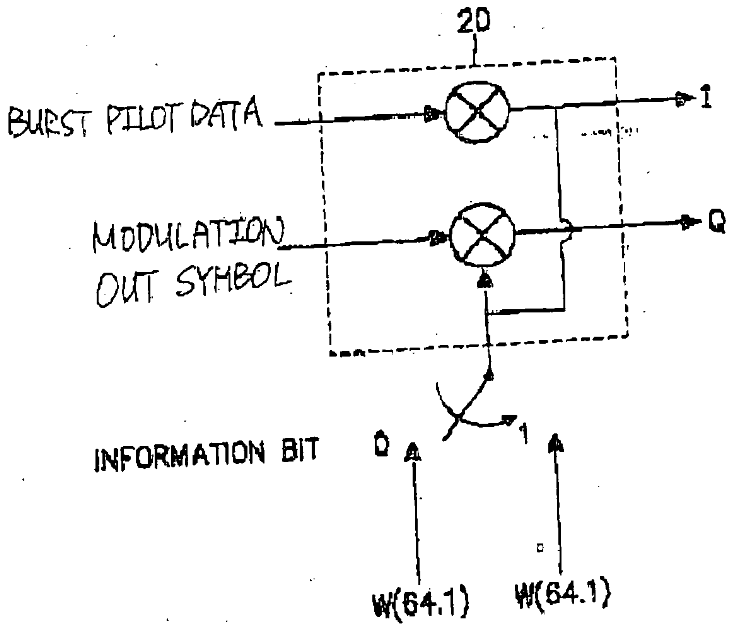
20
BURST PILOT DATA
I
MODULATION OUT SYMBOL
Q
INFORMATION BIT
0
1
W(64.1)
W(64.1)

FIG. 6B